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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Amateur Service Rules Concerning the 222-225 MHz and 1240-1300 MHz Frequency Bands	)))	PR Docket No. 92-289

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TO: The Commission

COMMENTS OF WAYNE OVERBECK, N6NB[1]

The following comments are offered in support of the Commission's Notice of Proposed Rule Making in the above captioned matter. While I concur fully with the Comments being filed in this proceeding by the Western States VHF-Microwave Society (WSVMS), of which I am a member, I am also filing my own comments for two reasons:

1) To discuss some of the policy implications of this proceeding in light of the dominant role of wide-bandwidth FM repeaters in the VHF-UHF amateur bands and the technological advances in communications now occurring; and

2) To place in the record a paper I published last year that summarizes the 60-year history of amateur experimentation in the 1.25 meter band, documenting significant contributions to the state of the art by radio amateurs.

My point, above all, is that experimentation and innovation by radio amateurs are still important--and that such activities cannot continue if the Commission abandons its

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1 I have been a licensed radio amateur since 1957 and active on the 222 MHz band since the 1960s. Although I served four terms as an elected vice director of the American Radio Relay League (ARRL), I hold no ARRL office now; the opinions expressed here do not necessarily reflect those of ARRL or any other organization. Outside of amateur radio, I hold Ph.D. and J.D. degrees and am a Professor of Communications at California State University, Fullerton. I have been a Member of the California Bar since 1975 and am the senior author of five books, including two college textbooks on communications law.

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traditional policy of preserving a portion of each VHF-UHF band for narrow-bandwidth, experimental modes. If the Commission allows every kiloHertz of the 1.25 meter band to be dominated by wide-bandwidth local repeaters (many of them closed or private), experimentation will be impossible. The experience of weak-signal experimenters and other non-FM operators in recent years makes it clear that without Commission action, there will be no segment of 1.25 meters reserved for experimental use on a nationwide basis.

THE PUBLIC POLICY IMPLICATIONS OF NON-REPEATER SUBBANDS

With due apologies to former FCC Chairman Newton Minow, who stunned the broadcast industry with his legendary "Vast Wasteland" speech more than 30 years ago,[2] the VHF-UHF amateur bands have become a vast wasteland in our largest cities.

In urban America the VHF-UHF amateur bands are almost completely occupied by repeaters and what the Commission calls "auxiliary stations," a great many of them private. An alarmingly small portion of our VHF-UHF bands is open for general use by all licensed amateurs. The most important issue in this proceeding, in my view, is whether some small portion of the 1.25 meter band will be reserved for general amateur use and narrow-bandwidth modes, or whether the Commission will allow repeater coordinators to take control of every kiloHertz of the band for their own constituents, who are too often the owners of closed communication systems rather than repeaters open to all amateurs.

In many major cities, every available repeater channel is occupied on two meters, 1.25 meters, 450 MHz, and--increasingly--the 1200 MHz band. In greater Los Angeles alone, there are more than 900 coordinated repeaters listed in the *ARRL Repeater Direc-*

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[2] Then-Chairman Minow delivered his "Vast Wasteland" speech on May 9, 1961, at an annual convention of the National Association of Broadcasters. He accused broadcasters of placing profits ahead of the public interest, and of wasting much of the vast potential of television by offering mediocre programming.

tory, with many additional private auxiliary stations of various types not even listed in the directory. Meanwhile, there are long waiting lists for any repeater channel that may become available for coordination, and uncoordinated repeaters are springing up wherever they are not prohibited by Part 97. The latter fact is a major problem for satellite and especially amateur television operators in our larger cities.

Does this mean the amateur VHF-UHF bands are saturated with activity? Absolutely not! For example, anyone who tunes across the 1.25 meter band, even during commuting periods, will find many unused channels. Even in a city such as Los Angeles, only a small percentage of the repeaters are in use at any given time. In fact, roughly half of the 900-plus listed repeaters (and all of the unlisted systems) are closed or private--not available for use by the great majority of the region's 40,000 radio amateurs.[3]

The VHF-UHF bands have become a vast wasteland because they are full of coordinated but closed repeaters and auxiliary stations--systems that are little used and off-limits to all but a privileged few. Once coordinated, these repeaters have the exclusive right to use 30 or 40 kHz segments of an amateur band, depending on the width of the designated input and output channels. If anyone other than the system's owner or his friends tries to use those channels for any purpose, the interloper is told quickly and emphatically to cease and desist. And the Commission's rules encourage this behavior by favoring coordinated repeaters--even private ones--with protection from interference by

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[3] The *ARRL Repeater Directory* uses the term "closed" to designate any system that is not open to all amateurs. However, some coordinators make a distinction between a "closed repeater" and a "private" one. A closed repeater is not open for general amateur use but is operated by a radio club or similar group that readily admits new members. Clubs sometimes operate a closed repeater to protect their dues-paying members' access to the repeater's telephone autopatch system. A private system, in contrast, is both closed (not open for general amateur use) and private in the sense that it is operated by an individual or group that does not routinely admit new members. It is difficult to see how the Commission's current regulations--which effectively empower repeater coordinators to grant even private repeaters the exclusive right to use major portions of the VHF-UHF amateur bands--could possibly serve the public interest.

uncoordinated stations that might be able to use some of these oft-silent frequencies.

Many of the private repeaters can only be regarded as *vanity repeaters*: they exist not to provide public service or liaison among members of a bona fide club, but instead as sources of personal gratification (and private mobile telephone service) for their owners and perhaps a few friends. The owners sometimes act as feudal liege lords, exercising absolute control over electronic castles. And these liege lords assemble periodically at round tables called repeater councils, acting to protect their own fiefdoms and those of allied barons--to the exclusion of all others who have a lawful right to use the VHF-UHF amateur bands. The result is that vast expanses of the VHF-UHF bands are off limits to most licensed amateurs, and these arrangements appear to be virtually permanent. Once coordinated, even private repeaters seem to have vested rights to "their" frequencies in perpetuity without any showing that these allocations are in the public interest. Even large, open clubs with strong commitments to public service often cannot break this coordination monopoly.

Granted, this is not the case in smaller cities and rural areas, where most repeaters are open for general amateur use--and often provide valuable public service. Even in cities such as New York and Los Angeles, some repeaters are not only open to all licensed amateurs but actually welcome strangers--and some urban repeater coordinators go to great lengths to accommodate the general amateur community.[4] But far too many urban repeaters are simply not available for general amateur use, and there are so many applic-

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[4] In fairness, I should point out that the Southern California Repeater and Remote Base Association (SCRRBA) has taken commendable steps to accommodate non-repeater activities such as weak-signal and satellite communications, amateur television, and digital modes in Southern California on those bands where it is the primary coordinating body (e.g., 50, 450 and 1200 MHz). Nevertheless, even SCRRBA cannot prevent uncoordinated repeaters from appearing wherever they are not prohibited by FCC regulations. And despite the good intentions of SCRRBA's leadership, a very large percentage of the 450 MHz amateur repeater subband is occupied by private systems and therefore off limits for general amateur use in Southern California.

ants for private and closed systems that even the most public-spirited coordinating bodies end up granting coordination to far too many closed systems.

There are those who would argue that the VHF-UHF bands are a vast wasteland in our largest cities for still another reason: because of the content of the communications that occur regularly on some of the repeaters. Much has been said and written, both in the amateur media and the popular press, about the so-called "filth repeaters" that are dominated by aspiring Howard Sterns and self-appointed vigilantes who would censor the Stern wannabes.

While the chaos on such repeaters may embarrass or anger many amateurs, such repeaters are at least heavily utilized, and they command large listening audiences. They meet certain needs of some radio amateurs, just as talk-formatted commercial radio stations meet such needs to the extent that they can without violating the Commission's indecency rule. And fortunately, there are only a few repeaters of this type. I would submit that a much larger problem is the huge number of silent channels--frequencies that are the de facto private property of a few privileged amateurs.

What makes the VHF-UHF bands a vast wasteland, then, is the fact that so little of each band is available for general amateur use, much less experimental use. And yet, we live in a time of rapid technological advances and accelerating demands on the radio spectrum, as the Commission knows only too well. Improvements in voice, data and video communication technology are occurring frequently, offering new opportunities for high quality, spectrum-efficient communications. Indeed, the Commission's goal in reallocating 220-222 MHz from the amateur service to land mobile was to foster the implementation of narrow-bandwidth communication technologies. Ironically, the Commission's reallocation of 220-222 MHz displaced narrow-bandwidth amateur operations (which occurred mainly below 222 MHz), and yet the Commission set aside no place for these activities in the remainder of the 1.25 meter band.

Other commenters have informed the Commission of the fact that there is simply no part of the 1.25 meter band available for weak-signal experimentation on a uniform, nationwide basis today. If the Commission does not act in this proceeding to set aside a small portion of 1.25 meters for non-repeater use, this band will be off limits for spectrum-efficient, narrow-bandwidth modes in an increasing number of regions.

<u>The Commission must not assume that this is merely a Southern California problem. It is not.</u> Every designated 1.25 meter repeater channel is assigned in a number of other cities, including New York and Dallas-Fort Worth, to cite just two examples. Without an FCC rule setting aside a portion of the 1.25 meter band for non-repeater use, it is only a matter of time until repeaters and auxiliary stations will occupy every possible channel in all large cities. Even if a local coordinating body voluntarily reserves a part of the band for non-repeater use, uncoordinated repeaters will surely move in where coordinated ones are barred. The fact that so many amateurs desire to have their very own private repeater--even when many other repeaters are little used--assures that this will happen in the absence of Commission action.

As the Commission is well aware, the amateur service is growing rapidly today, and most of that growth is in the code-free technician class license. Most of these new amateurs are attracted to FM repeater activity, and a significant number of them aspire to own their own repeaters--equipped with private telephone autopatch facilities--instead of using existing, open repeaters that may lack autopatches. Indeed, in my area a significant number of the newcomers see amateur radio as an alternative to cellular telephone service. Under those conditions, wide-bandwidth, local FM repeater communications will inevitably displace other amateur activities unless the Commission continues to reserve a portion of each band for other uses. With almost 600,000 licensed amateurs in the United States (including nearly 200,000 technician class licensees and another 100,000 novices who would gain broad repeater ownership privileges in this proceeding), we cannot continue to provide a private repeater channel pair for the exclusive use of every amateur who wants to own a private system.

It is vital for the Commission not only to reserve a small portion of 1.25 meters for non-repeater use, but also to adopt policies that will encourage more amateurs to utilize spectrum-efficient communication technologies. Equally important, the Commission must develop regulations that will encourage the establishment of open repeaters, not private ones. As the amateur service continues to grow, it will become increasingly important for the Commission to assure that the VHF-UHF bands are open to all licensees to the greatest extent possible. Today's FCC should encourage amateurs to serve the public interest rather than merely protect their own private interests, just as Minow's FCC encouraged broadcasters to consider the public interest and not just private gain 30 years ago.

THE LEGACY OF AMATEUR EXPERIMENTATION ON 1.25 METERS

The attached paper, *Weak Signal DXing on 222 MHz: Past, Present and Future*, was first presented at the 37th Annual West Coast VHF-UHF Conference last May, and was later published by the American Radio Relay League (ARRL) in the *Proceedings* of that conference.[5] It was subsequently quoted or reprinted in several other publications.

The paper traces the history of amateur experimentation on the 1.25 meter band

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[5] *Proceedings of the 37th Annual West Coast VHF/UHF Conference*, published by the American Radio Relay League, Inc., Newington, CT, 1992., p.134-146.

since the first documented two-way contacts occurred during the early 1930s. Actually, the FCC did not formally designate 1.25 meters as an amateur band until 1938. However, in 1933 the Federal *Radio* Commission authorized amateurs to operate on any frequency above 110 MHz, and amateurs soon chose 224 MHz for experimental activities because of its harmonic relationship to the lower-frequency amateur bands in use at the time (3.5, 7, 14, 28 and 56 MHz).

Through perseverance and persistence over the years, amateur experimenters repeatedly contributed new knowledge about VHF-UHF radio communications by their work at 1.25 meters. Again and again, amateurs were the first to observe and document propagation phenomena that were not thought to occur at frequencies above 200 MHz. For example, radio amateurs were the first to demonstrate that communication by auroral propagation was possible at 220 MHz (in 1954). In 1959, two radio amateurs astonished the scientific world by completing two-way communication from Southern California to Hawaii on 222 MHz, spanning a 2500-mile path by a little-known propagation phenomenon: long-haul over-water tropospheric ducting. What these radio amateurs discovered compelled the U.S. military (among others) to revise their thinking about the presumed security of military communications at sea.

In 1968, radio amateurs were again at the forefront of propagation experimentation, proving that meteor scatter communication over paths in excess of 1000 miles was possible at 222 MHz. In 1970, amateurs succeeded in communicating via e.m.e. ("moonbounce") propagation on 222 MHz.

Perhaps no amateur propagation breakthrough on 1.25 meters produced more amazement in the scientific community that the two that occurred during the 1980s: the first sporadic-E communication on 220, and the demonstration that transequatorial F-layer ionospheric propagation occurs at 220 MHz. The surprising demonstration of F-layer propagation on 1.25 meters came in 1983, when an amateur operator in San Juan, Puerto Rico, completed a two-way contact with another amateur near Buenos Aires, Argentina, spanning a distance of 3670 miles on 220 MHz! The first 222 MHz sporadic-E contact occurred during 1987. Like many of the earlier propagation breakthroughs, these achievements contradicted widely held beliefs--and they were possible only because amateurs in widely scattered places were free to engage in weak-signal communication on nationally and internationally standardized calling frequencies within the amateur 1.25 meter band.

Of major significance to this proceeding is the fact that Southern California amateurs were involved in three of these propagation breakthroughs, something that simply could not happen today because repeaters occupy every channel in the national weak-signal subband. Like other weak-signal operators, I have been frustrated repeatedly in my attempts to squeeze in between repeaters and make long-distance contacts using CW or SSB emissions. Many repeater owners seem determined not to share "their" frequencies--even when the repeater has not been used for an extended period of time. If technical experimentation by radio amateurs is to continue, some portion of each amateur band must be preserved for non-repeater activities. It has become painfully clear that without Commission action, this will not happen on a uniform, nationwide basis.

CONCLUSION

Radio amateurs have a long and distinguished record of contributing to the state of the art by their experimental activities on the amateur bands. The kind of VHF propagation experimentation that is described in the attached paper simply cannot occur on the 1.25 meter band today in my geographic region. It is in the public interest for the Commission to protect and encourage experimentation by radio amateurs--experimentation not only with little-known propagation phenomena but also with spectrum-efficient modes of communication.

For these reasons, I urge the Commission to reserve a small portion of the 222-225 MHz band for non-repeater use.

Respectfully submitted,

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February 19, 1993

APPENDIX A

Reprinted from the *Proceedings of the 37th Annual West Coast VHF/UHF Conference,* published by the American Radio Relay League, Inc., Newington, CT, 1992., p.134-146.

Weak Signal DXing on 222 MHz: Past, Present and Future

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When the Federal Communications Commission reassigned the bottom 2 MHz of the 1.25 meter band for non-amateur use last summer, that event marked a crucial turning point in the history of the band. Although the FCC took away 40 percent of the band, the FCC also ended nearly two decades of uncertainty about the entire band's status by recognizing amateur radio as the primary user of the remaining 3 MHz. And it forced amateurs to ask some basic questions: questions about the attributes of the band itself, and questions about how the remaining 3 MHz can best be utilized.

Perhaps this is a good time to look back at the major accomplishments by radio amateurs on 1.25 meters over the last 58 years, a time to recall the repeated examples of amateurs advancing the state of the art by their persistent and painstaking experimentation on this band. Amateurs have often astonished the scientific community by demonstrating that propagation phenomena thought to be non-existent at such high frequencies do in fact occur at 220 MHz.

PIONEERING VHF EXPERIMENTERS

The 1.25 meter band has a long history. Radio amateurs were the first to establish any kind of reliable communication in this part of the spectrum--and they did it in 1934 by making contacts regularly on 224 MHz--several years before 1.25 meters was officially designated as a "band." In 1933, the Federal Radio Commission, the forerunner of the modern FCC, had authorized amateurs to operate on *any* frequency above 110 MHz for experimental purposes![1]

By then, the FRC had already authorized amateur operation on a series of harmonically related bands: 160 meters, 80 meters, 40 meters, 20 meters, 10 meters and 5 meters. In fact, by 1934 hundreds of amateurs were using 5 meters for local communication, talking across town with inexpensive and easy-to-build modulated oscillators and superregenerative receivers. In these simple units, the same vacuum tube often functioned as the modulated oscillator in the transmit mode and as the superregenerative detector on receive. Only a few other tubes were needed to complete the system: a rectifier, a speech amplifier, and a modulator (which often functioned as an audio amplifier on receive as well).

Even using this simple equipment, early VHFers discovered--quite by accident--that occasionally they could work stations about 1,000 miles away, especially during June and July. They had, of course, stumbled upon what we now know as E-skip! And by 1935 they had discovered something else that represented a major scientific breakthrough: while VHF signals could be heard beyond the optical line of sight at all times, at certain times signals became much stronger and spanned paths of more than 100 miles.

Ross Hull, W1AL, a legendary VHF pioneer, played the key role in this early amateur experimentation, and with his perseverance he set the pattern for many other amateurs who would later make major contributions to science through their VHF/UHF activities. Hull arranged to make a 24-hour daily record of signal strengths over the 125-mile path from Boston to the Hartford area. Then he tried to correlate the signal variations with changes in any observable natural phenomena: the weather, temperature, barometric pressure, lunar cycles--anything. He ultimately concluded that VHF waves were bent along air-mass boundaries: he and his amateur collaborators had discovered tropospheric refraction! Hull's achievement was hailed at the time as "one of the truly outstanding examples of scientific achievement by an amateur in any field of human endeavor."[2]

The record of amateur activities on 1.25 meters during the 1930s and 1940s is sparse. However, we do know that as 5 meters grew in popularity, the limitations of modulated oscillators and superregenerative receivers became painfully apparent--a fact that actually helped foster 1.25 meter activity. Modulated oscillators proved to be so unstable that only a few stations could operate at any given time in one geographic area. Also, superregenerative receivers not only had very poor selectivity but also were notorious for radiating a loud signal, thus causing serious problems for nearby stations.

In 1938, the FCC banned modulated oscillators on 5 meters to solve interference problems that had become intolerable. That led to a major exodus of amateurs to the newly designated 2.5 and 1.25 meter bands (at 112-116 MHz and 224-230 MHz, respectively), where modulated oscillators were still permitted then. Modulated oscillators did much to popularize 1.25 meters, especially when amateurs were allowed back on the air after World War II. By then, the military's need for radar and VHF communications had given amateurs a variety of vacuum tubes and other components suitable for VHF/UHF experimentation. The FCC eventually prohibited modulated oscillators on all bands below 220 MHz, leading many who wanted a simple, inexpensive unit for reliable local communications to move up to 1.25 meters.

POSTWAR DEVELOPMENTS

After the war, amateurs were given six and two meters in place of the old five and 2.5 meter bands as the FCC juggled assignments to come up with the most suitable spectrum for television and FM radio broadcasting, among other services. The result of all this was that although amateurs got to keep 1.25 meters (or some of it, anyway: 220-225 MHz), the two lower VHF bands that were harmonically related to the HF bands were lost.

Another major change in amateur radio after World War II also gave impetus to activity on the 1.25 meter band: the creation of the technician class license. The FCC established both the novice and technician class licenses in 1951. Originally techs were permitted to use only frequencies above 220 MHz. (Full VHF privileges for techs came slowly: they were given six meters in 1955, but they were not allowed on two meters until

1959, and even then they were limited to the 145-147 MHz portion of the band. They finally gained access to the full two meter band in 1978).

Indicating the initial enthusiasm about the novice and technician class licenses, the FCC reported issuing 1,099 novice and 294 technician class licenses during July of 1951, the first month the new licenses were available.[3] Those figures are particularly amazing because in those days not even the novice and technician license exams were given in the field by volunteers. Even applicants for the novice license had to travel to an FCC field office in a major city and take the exam! And yet, a review of 1951 issues of *QST* reveals an enthusiasm for those new licenses not unlike the enthusiasm that greeted the no-code technician license 40 years later. Hallicrafters, one of the leading amateur equipment manufacturers in those days, published full-page *QST* ads proclaiming that Bill Halligan, Jr., the company's sales manager, had earned a novice license. The ad even featured a large reproduction of his novice license!

But not all 1.25 meter operators were beginners. By the early 1950s, a number of amateurs had built much more sophisticated equipment for 220: crystal controlled transmitters with several multiplier stages ahead of a straight-through final amplifier, and receiving converters with stable crystal controlled local oscillator chains. Indeed, *QST* was full of construction articles about that sort of high performance equipment for 220 in those days. By the late 1950s, amateurs could even buy such equipment factory wired and tested: the Tecraft company sold a crystal controlled 20-watt AM/CW transmitter for $59.95, and offered a sensitive (by 1950s standards), stable receiving converter for $44.95. (In 1961, Gonset introduced a new version of the famous Gonset Communicator called the Communicator IV, and for the first time a 220 model was offered. However, the 220 Communicator IV seemed prohibitively expensive to most amateurs: it sold for $400 in 1961 dollars, and it was still just a low-power AM transceiver).

In the early 1950s some of the better-equipped 220 MHz operators began to explore the DX possibilities offered by the tropospheric enhancement that is so common in the eastern United States. The 220 MHz DX record was extended to 300 miles, 500 miles, and then 700 miles. By 1953, serious 220 operators were wondering whether other modes of propagation that were being observed at two meters also occurred at 220. The "experts" of the day were doubtful, of course, but a number of amateurs persisted in their propagation experiments.

PROPAGATION BREAKTHROUGHS ON 1.25 METERS: AURORA

The first major breakthrough in 220 MHz non-tropospheric propagation experimentation came on April 11, 1954, during what was billed as the best two-meter aurora propagation in several years.[4] While most serious VHFers were busy working DX on two meters, Fred Tuckerman, W3LZD, searched that band for other amateurs with good 220 MHz stations. His efforts resulted in the first two complete aurora QSOs on 220 MHz. First he worked W8DX, and then W8BFQ. His conclusion: aurora-reflected signals were nearly as loud on 220 MHz as on two meters, but the notorious aurora distortion was more severe.

220 MHz was the highest frequency on which aurora propagation had been observed up to that time by anyone, including academic and government researchers. Today

aurora communication is commonplace on 220, but what may be obvious with hindsight was not at all apparent to these weak signal pioneers. Like the earlier discoveries of VHF tropospheric enhancement and E-skip propagation, the discovery that auroral propagation was possible at frequencies above 200 MHz was made by amateurs and demonstrated to dubious scientists.

In the decades since the first communication by aurora on 1.25 meters, radio amateurs have repeatedly shown that other propagation modes are usable at this frequency--confounding the scientific community again and again.

TROPOSPHERIC DUCTING

Probably no VHF/UHF breakthrough has ever been more widely celebrated, nor the people who achieved it more lionized, than when John Chambers, W6NLZ, and Ralph Thomas, KH6UK, completed their astonishing two-way communications between California and Hawaii on two meters in 1957 and on 222 MHz in 1959. Both achievements virtually doubled the former terrestrial DX records on those bands, and both shocked just about every scientist who had any grasp of VHF/UHF propagation phenomena.

Of the two record-breaking contacts, the 1.25 meter contact was by far the easier one. To make their contact on two meters, it took W6NLZ and KH6UK nine months of frustrating nightly schedules--and a lot of faith to carry on in the face of repeated failures when all the odds seemed to weigh so heavily against them. But when they switched to 222.07 MHz two years later, they made their historic contact during their fifth night of schedules, on June 22, 1959! Certainly their impression--a belief now shared by many other amateurs who operate on both bands--was that tropospheric propagation is even better on 222 MHz than it is on two meters. Here, they concluded, was a band that had amazing potential for long-distance amateur communication by tropospheric ducting. (Still later, the pair attempted to communicate on 432 MHz, but they never completed a two-way contact on that band, largely due to a receiver problem at KH6UK. However, others have more recently made two-way California-to-Hawaii contacts on 432 and higher UHF/microwave bands).[5]

To make their contacts, the pair used equipment that was then near the state of the art, such as "low-noise" (i.e., perhaps 4 dB.) vacuum tube receiving front ends, multi-bay Yagi antennas, and kilowatt CW transmitters with 4X250 family final tubes. Chambers' system was built around a Collins KWS-1 transmitter, using linear transverters. He was among the first to operate a high power SSB station with a truly stable, v.f.o.-controlled transmitter on 1.25 meters. For most serious operators on the band then, a crystal-controlled CW/AM transmitter still meant high performance.

The fallout from Chambers' and Thomas' accomplishments continued for many years. The U.S. Navy launched a major study of over-water tropospheric propagation, sensing the military implications of the discovery that "local" VHF/UHF signals could sometimes be received by a potential enemy thousands of miles away. Their findings confirmed that what Chambers and Thomas had done was no fluke, and authors around the world scurried to rewrite textbooks about VHF/UHF propagation.

For Chambers and Thomas personally, their perseverance and ultimate success won them enormous acclaim. They were jointly given the 1960 Edison Award, which was widely regarded as the highest honor in amateur radio. It was the only time this award was given for scientific achievement; all of the other annual winners were honored for public service activities. The award was presented at a banquet in Chambers' and Thomas' honor by then-FCC Chairman Frederick Ford. Ford gave a speech praising their work as being in the best tradition of experimentation by radio amateurs and a major contribution to the state of the art.[6]

After Chambers' untimely death from a brain tumor at age 49 in 1969, the Central States VHF Society created the John Chambers Memorial Award in his honor--and promptly made Ralph Thomas the first annual recipient.

METEOR SCATTER

After the Pacific was spanned on 1.25 meters, other propagation breakthroughs followed. In 1968, several radio amateurs proved that it was quite possible to communicate via meteor scatter at this frequency. Like aurora work, meteor scatter work on 222 MHz is routine today, but it was by no means obvious in an earlier era that this mode was usable on 1.25 meters.

Mel Baer, W6WSQ, and Don Hilliard, WØEYE, ran meteor scatter schedules for two months during the summer of 1968, hoping to complete a contact over an 825-mile California-to-Colorado path via ionization from random meteors. They heard some bursts almost every day, but they did not finally complete a two-way contact until August 9, during the Perseids meteor shower. Only two days later, on August 11, 1968, two other amateurs (John Perchalsky, K4IXC, in Florida and "Jud" Snyder, K2CBA, in New York) completed a second 220 MHz meteor scatter contact, this one over a 1090-mile path. The very next day (August 12), W6WSQ and WØEYE completed another meteor scatter contact.[7]

How does meteor scatter communication on 1.25 meters compare to two meter m.s. work? The general consensus today--after thousands of successful meteor scatter contacts on 1.25 meters--is that signal levels are perhaps a little lower and that the meteor bursts tend to be shorter, rendering this form of communication more difficult on 1.25 meters than it is on two meters.

MOONBOUNCE

Less than two years after the first meteor scatter contacts on 220, Jud Snyder was again involved in a communication breakthrough when he joined two other well-known VHFers in pioneering moonbounce communications on this band. Of all the propagation modes that had been utilized on 220 by then, moonbounce required the most sophisticated hardware. Every moonbounce contact was a major achievement with the technology of that era. But ironically, communicating via the moon on 220 was also the one propagation breakthrough that was not too surprising to the scientific community. By then receiver and antenna technology had advanced to the point that EME communication was possible (although very difficult) with amateur power levels: that had already been proven on other bands. What was required for the first moonbounce work on 220 was for a group of technically skilled amateurs to roll up their sleeves and build stations with sufficient system gain to overcome the path loss on the half-million-mile trip to the moon and back. The experts knew it was possible on 220; somebody just had to *do it!* (With the high gain antennas and low noise receiver front ends available in 1992, of course, EME communication has become almost routine for well-equipped stations. Many VHF/UHF DXers now work stations thousands of miles away via the moon on a daily basis, but that wasn't happening in 1970).

The first successful 1.25 meter moonbounce contact was between Louis Anciaux, WB6NMT (now KG6UH), and "Lucky" Whitaker, W7CNK, on March 15, 1970. The following evening, WB6NMT completed the second moonbounce contact--with K2CBA. The trio were all running full-kilowatt CW transmitters, with "low-noise" (i.e., about 2 dB.) receiving front ends and antenna arrays having gains on the order of 20 dBd.[8] They and others since have found that EME conditions are generally similar on two meters and 220, although Faraday rotation changes more slowly on 220, making it more desirable to have a means of changing the antenna polarization on 220. On the other hand, sky noise is generally lower on 220, and a given antenna gain is, of course, achievable in a smaller package on that band.

WB6NMT, W7CNK and K2CBA were honored for their pioneering 1.25 meter moonbounce work by being named as co-winners of the 1971 ARRL Technical Merit Award.

NO MORE WORLDS TO CONQUER?

By the early 1970s, the prevailing view might have been that there were really no more worlds to conquer on 1.25 meters--at least in terms propagation discoveries. The conventional wisdom then was that every propagation mode that could possibly be operative at 220 MHz had been explored. However, the experts were to be proven wrong again--more than once.

During the intense sunspot peak of 1979-81, many six meter DX records were shattered; the m.u.f. for F_2 layer propagation exceeded 50 MHz almost daily for weeks at a time. During that period, transequatorial scatter propagation, which results from irregularities in the F-layer of the ionosphere near the magnetic equator, became commonplace on two meters. There were many 3,000, 4,000 and even 5,000-mile 144 MHz contacts between stations located strategic distances north and south of the magnetic equator during this period. That was an amazing propagation breakthrough, but no one really thought that kind of ionospheric propagation was possible at 220 MHz. *True skywave propagation just doesn't happen on 220, right?*

Wrong again. On March 9, 1983, it did happen. After several months of schedules, KP4EOR, near San Juan, Puerto Rico, and LU7DJZ, near Buenos Aires, Argentina, completed a two-way CW contact with solid signals both ways, setting a new terrestrial DX record of 3670 miles on 1.25 meters. The idea of communicating that far on that high a frequency by transequatorial scatter or any other form of skywave propagation was considered absurd--until two persistent amateurs proved that it could be done![9]

Moreover, in 1987 two other weak signal experimenters proved that another form of skywave propagation occurs on 220 MHz: E-skip! A very intense E-skip opening occurred during that year's June VHF Contest, which is a time of extremely high VHF/UHF activity. The opening reached two meters and lasted for several hours--a very unusual occurrence. As conditions peaked on two meters, K5UGM near Dallas easily worked W5HUQ/4 near Jacksonville, Florida on the national calling frequency of 220.1 MHz. Signals were 40 to 60 dB. over S9 during the contact, even though W5HUQ was running only 20 watts to a single Yagi.

To most experts on propagation, the idea of E-skip communication at 220 MHz would have seemed preposterous, but once again two amateur experimenters were able to prove it could be done. A review of the tapes and notes made by both operators made it clear that this was indeed an E-skip contact.[10] In fact, hindsight suggests that 220 MHz E-skip openings occur periodically and went undiscovered for so many years only because they invariably happen at times when there is also excellent E-skip propagation on two meters. A good two-meter E-skip opening is unusual enough that most VHF DXers tend to be preoccupied with the action there; few would be inclined to leave a wide open two meter band to check on 220. To make the 1987 contact, K5UGM repeatedly queried operators in suitable locations on two meters until he found someone with 220 capability. Without that kind of persistence, this pioneering contact might never have occurred.

WORKING ALL 50 STATES ON 220

Sheer operating persistence led to another kind of achievement on 1.25 meters in the 1980s: ten different stations succeeded in working all 50 states on this band! The first 220 MHz Worked All States award went to WØVB in late 1983. Shortly later, WØSD and WBØTEM submitted their QSL cards simultaneously to tie for WAS award #2. All used a combination of propagation modes, including moonbounce, to achieve this goal.

The manner in which these amateurs earned their 220 MHz Worked All States awards is a classic example of the dedication that has so often been displayed by amateurs in pursuit of a goal. Three intrepid amateurs from the upper midwest, WØSD, WBØPJB and WBØTEM, put together a mid-winter moonbounce expedition to eight northeastern states that a number of 1.25 meter DXers still needed for the WAS award. They left Iowa in a howling snowstorm on December 14, 1983, drove to the east coast, repeatedly set up and dismantled a large moonbounce array in near-zero temperatures, and finally returned home on December 24 in another snowstorm. By the time their whirlwind trip was over, they had completed 75 220 MHz EME contacts and helped 14 different stations move closer to their WAS award on 220.[11] As the accompanying chart indicates, by 1991 a total of ten different stations had worked all 50 stations on 1.25 meters.

Working all states on a band like 1.25 meters might have seemed to be out of the question until recently. What made such a seemingly difficult feat attainable by a number of different stations in the 1980s?

Perhaps part of the answer is that there was a significant increase in the number of well-equipped 1.25 meter stations during the 1970s and 1980s. By the mid-1980s, Lee Fish, K5FF, who has been a longtime advocate of DXing on 1.25 meters, could count 46 states that had at least one serious 220 MHz DXer on the air. All of the heavily populated states, of course, had many. And perhaps another part of the explanation is that moon-bounce work became much more feasible as receiver front ends improved. When John

Chambers and Ralph Thomas spanned the Pacific on 222 MHz in 1959, a vacuum tube front end with a 4 dB. noise figure was considered good. Today any receiving preamplifier with a noise figure in excess of .5 dB. would be considered something less than state of the art. By the 1980s, a group could set up a EME station in eight states in 11 days in the middle of winter, completing 75 EME contacts along the way. Clearly, 220 had become a DX band in the true sense of the word by then.

1.25 meter WAS award holders

1. WØVB (Minnesota)
2. WØSD (South Dakota)
2. WBØTEM (Iowa)
4. K5FF (New Mexico)
5. W5FF (New Mexico)
6. WB5LUA (Texas)
7. VE3EMS (Ontario)
8. W3GPY (Pennsylvania)
9. K9KFR (Indiana)
10. KAØY (Iowa)

1.25 METERS IN TRANSITION

While weak signal DXers were achieving technical breakthroughs on the 1.25 meter band, there were other forces at work--forces that would fundamentally alter the character of the band--or what amateurs have left of it.

In 1971, the Electronic Industries Association (EIA) petitioned the FCC to reallocate the 220-222 MHz portion of the band for a new "Class E" citizens band. That set in motion a series of events that left the status of the band uncertain for the better part of 20 years--and resulted in profound changes in the operating mix among amateurs on the band.

By 1973, it seemed likely that the FCC would grant the EIA's request in some form. The Commission issued a combined Notice of Inquiry and Notice of Proposed Rulemaking in June of that year, proposing a Class E citizens band at 224-225 MHz. However, the American Radio Relay League and other amateur interests launched a massive campaign to defeat the EIA proposal and "save 220." But in 1974 the Office of Telecommunications Policy (now the National Telecommunications and Information Administration) threw an astonishing monkey wrench into the works by sending a letter to the FCC to recommend a citizens band at 222-224 MHz rather than 224-225 MHz. The OTP had its own reasons for this proposal (many thought it had to do with government concerns about an unruly new citizens band ending up too close to frequencies above 225 MHz that were used by government agencies). But the result was that the ARRL demanded a new opportunity to comment on the matter because the OTP proposal was so different from the one amateurs had commented upon earlier.

In 1975, the FCC voted to delay action on Class E while additional internal studies of the matter were conducted. By 1977, the commission staff had serious doubts about the wisdom of creating a Class E citizens band at all, much less at 220 MHz. In that year the FCC voted to terminate the Class E proceeding, and a year later the Commission directed its staff to study the possibility of establishing a personal radio band at 900 MHz. That idea, too, was later abandoned.

Thus, amateurs won a major battle, and some thought the war for 220 was over for good. In 1979, *QST* published an article chronicling the entire Class E proceeding that was entitled, "The Band We Almost Lost." Few people then could foresee that the Commission would find another use for the 220-222 MHz band segment in the 1980s--and would take it away after all.[12]

Meanwhile, the FCC's action on Class E left several equipment manufacturers in a bind. They had invested heavily to gear up for production of 220 MHz FM transceivers for the anticipated CB market, and they needed to recoup their investment. One Japanese manufacturer had already mass-produced thousands of transceivers, and they were ultimately sold *to amateurs* under the Midland 13-509 name (the same unit was also marketed under the CB brand name of Cobra). Radio clubs were offered package deals in which their members could buy the Midland 13-509 for the fire-sale price of $150--about half of what similar FM transceivers for other bands cost at that time.

At the same time, the two meter band became saturated with repeaters in several of the largest cities, including Los Angeles. Many clubs that wanted a club repeater could not get a channel pair--unless they went to 220.

The result was predictable and inevitable: thousands of newcomers showed up on 220 almost overnight. During the 1976 June VHF Contest, this author found almost no one to work on the national FM simplex calling frequency of 223.5 MHz, even from a mountaintop with a commanding view of much of California. But in the 1977 June VHF Contest, it was possible to work more than 100 stations on 223.5 in less than two hours of operating time there! (The author won the contest nationally both years, but all those extra 220 contacts--each worth two points--surely helped in 1977). By the 1978 June VHF Contest, there were almost as many stations to work in Southern California on 223.5 MHz as there were on 146.52, the two-meter simplex calling frequency (which was later declared off limits to VHF contest activity).

DXING IN THE REPEATER ERA

During the 1970s, 1.25 meters was also rapidly filling up with FM repeaters, remote bases and auxiliary links. A series of turf wars were fought over the coordination of these activities. In California, the California Amateur Relay Council, which had functioned as a repeater coordinator for many years, was eventually divided into separate northern and southern components, and the southern component divided and then divided again--resulting in the formation of the 220 Spectrum Management Association (SMA) as a separate 1.25 meter repeater coordinating body in Southern California. (During the 1980s, there was still another division in the repeater community when a group that was dissatisfied with its treatment by SMA formed the 220 Frequency Coordination Council. That group eventually won FCC recognition as a rival coordinating body, but later reached a settlement with SMA). In the north, the Northern Amateur Relay Council remained intact, providing repeater coordination for a number of different bands, including 1.25 meters.

This explosion of 220 FM activity turned out to be a mixed blessing. On one hand, it may have helped dissuade the FCC from seeking to reallocate more than 2 MHz of the band in its recent action. But on the other, the proliferation of repeaters in the 222-225 MHz band segment made it difficult for non-repeater operators to find operating space when the 220-222 MHz band segment, including the former weak signal subband, was withdrawn from amateur use last year.

It is beyond the scope of this paper to discuss all the ramifications of some repeater coordinators' efforts to keep virtually the entire 1.25 meter band for repeater use, thus denying weak signal operators reasonable access to the band. However, the weak signal community pioneered the use of this band; they clearly have the right to continue operating on 1.25 meters in every state and every country where it is recognized as an amateur band. No one can seriously argue, after all, that there is no further need for scientific experimentation in the amateur radio service. No one knows what new discoveries await future amateur experimenters. And it is also obvious that weak signal DXing is a nationwide and world-wide activity; it is by no means a form of local communication. If each local repeater coordinator adopts its own 1.25 meter band plan after considering only local activity patterns and needs, the inevitable result will be a chaotic patchwork of incompatible weak signal band segments. That would make weak signal operating difficult if not impossible.

In light of the vote last year by 220 SMA to retain the first repeater input at 222.020 MHz (thereby limiting weak signal users to the bottom 10 KHz of the new band), this possibility must be taken seriously. Without a uniform, national weak signal subband on 1.25 meters (including a repeater-free national calling frequency), it will be impossible to explore long-distance propagation modes in the future (especially during unexpected band openings), and the entire band may be relegated to purely local communications.

In a *QST* article on band planning in January, 1992, longtime 220 SMA official Karl Pagel, N6BVU, offered this observation:

> There is no such thing as a national standard. Southern California is surrounded by mountains, so on VHF we're cut off from the rest of the country. What we do here does not affect anyone else, and vice versa.[13]

That statement is astonishing in light of the long history of weak signal DXing on 220 in Southern California. Not only did several of the headline-making firsts in propagation experimentation occur here, but weak signal operators have been routinely communicating beyond the jurisdiction of 220 SMA for three decades! For example, Joe Burke, K6IBY, of Costa Mesa, Calif., has been running tropo schedules on 220 with various stations in Northern California and Nevada several times a week since the early 1960s. It is absurd to suggest that Southern California is "cut off from the rest of the country."

Because weak signal experimentation is in jeopardy if every repeater coordinator adopts its own local band plan and ignores the fact that some VHF/UHF activities are not local, the ARRL Board of Directors voted overwhelmingly last year to ask the FCC to set aside a small portion of the 1.25 meter band for non-repeater use on a uniform, national basis.[14] The resulting FCC petition, designated as RM-7869, asks that 150 KHz--five percent of the remaining band--be reserved for non-repeater use. For comparison, before amateurs lost the bottom 2 MHz of the band, 10 percent of the band was reserved by FCC rule for non-repeater use: 220.0-220.500 MHz.[15] Much larger segments of other VHF bands are still set aside for non-repeater use by the FCC: repeaters are excluded from 25 percent of six and two meters and 17 percent of 70 cm.

Another factor that must be considered is that uncoordinated repeaters are now showing up almost everywhere that they are not specifically prohibited by law in the VHF amateur bands. Any quiet, weak signal band segment that is not protected by law is vulnerable to that kind of encroachment, even if a local repeater coordinator makes adequate provision for weak signal operation in a voluntary band plan.

Whether future weak signal experimentation will be possible on the 1.25 meter band will depend in large part on whether there is a uniform national non-repeater sub-band. Without RM-7869--or something like it--the last chapter in the story of weak signal experimentation on the 1.25 meter band may have already been written.

REFERENCES

1. For an excellent summary of the early history of amateur VHF experimentation, see DeSoto, Clinton B., *200 Meters and Down*, The American Radio Relay League, Inc., West Hartford, CT, 1936.

2. For a fuller description of Ross Hull's historic tropospheric refraction experiments, see Tilton, Edward P., *The Radio Amateur's V.H.F. Manual*, The American Radio Relay League, Inc., Newington, CT, c.1968.

3. "Happenings," *QST*, September, 1951, p. 36.

4. Tilton, Edward P., "The World Above 50 Mc.," in *QST*, June, 1954, p. 61-62.

5. Tilton, Edward P., "The World Above 50 Mc.," in *QST*, September, 1957, p. 62-63 and *QST*, August, 1959, p. 68-69.

6. "1960 Edison Award to W6NLZ and KH6UK," *QST*, April, 1961, p. 48-49.

7. Smith, Bill, "The World Above 50 Mc.," *QST*, October, 1968, p. 94.

8. Smith, Bill, "The World Above 50 Mc.," *QST*, May, 1970, p. 83.

9. Tynan, Bill, "The World Above 50 MHz," *QST*, May, 1983, p. 74.

10. Tynan, Bill, "The World Above 50 MHz," *QST*, September, 1987, p. 67.

11. Gray, Ed, Barry Arneson, and Marc Thorson, "East Coast 220-MHz EME DXpedition," *QST*, April, 1984, p. 65.

12. Steinman, Harold M., "The Band We Almost Lost," *QST*, January, 1979, p. 54-55.

13. Quoted in Wilson, Mark, "Spectrum Management in the '90s and Beyond," *QST*, January, 1992, at p. 72.

14. See Minute 67 in "Moved and Seconded... Minutes of the 1991 Second Meeting of the Board of Directors, the American Radio Relay League, Inc., July 19-20, 1991," *QST*, September, 1991, p. 57-59. The vote to petition the FCC for a 222 MHz non-repeater subband was 13-1-1, with Fried Heyn voting no and Mary Lewis abstaining.

15. Not even an FCC rule excluding repeaters and "auxiliary" stations from a segment of a band can assure that they will not operate there. Although the FCC prohibited repeaters and auxiliary stations in the old 220.0-220.500 weak signal band segment, 220 SMA adopted a band plan that purported to limit weak signal operation to the bottom 100 KHz, with 220.100-220.500 reserved for auxiliary links--in violation of the FCC rule. Only an FCC rule *that is enforced* (and honored in good faith by repeater coordinators) can preserve a non-repeater subband.